

REMARKS

Claims 1 through 23 are in the application and are presented for consideration. By this amendment, Applicant has made clarifying changes to independent claims 1 and 14. Additionally, minor changes have been made to some of the other claims.

The drawings have been objected to as failing to show “an intersection (18)” as described in the specification. Applicant requests acceptance of the drawing corrections submitted herewith including a replacement sheet of Figure 9. This properly indicates the intersection 18.

Claims 1 through 13 and 23 have been rejected as being indefinite. Applicant has now revised the claims paying close attention to the comments in the office action. Applicant wishes to thank the Examiner for the careful reading of the claims and for the helpful comments. It is Applicant’s position that the claims as now presented are clear, definite and fully conform with the requirements of the statute. With regard to the term “at least partially oppositely” this term relates to at least some component of the compensating motion being in a direction which is opposite to the direction of the displacing motion provided by the manipulator.

Claims 1 through 3, 6 through 16, and 20 through 23 have been rejected under 35 U.S.C. 102 (a) as being anticipated by Torii et al. (US 5,132,887). The rejection is based on the position that Torii et al. discloses each of the features as recited in the claims.

Independent claims 1 and 14 have now been rewritten to highlight the important combination according to the invention. With the invention the laser tool is moved along a

working path on the workpiece based on a displacing movement of the manipulator. In addition, there is superimposed an at least partially oppositely directed compensating motion of the laser beam with respect to the displacement motion. The superimposed compensating motion occurs during the displacement motion. This is quite significant as the displacement motion of the manipulator (for example a six axis multiaxial robot) can be increased with regard to speed. As explained in the application, it is advantageous to avoid acceleration or deceleration of the manipulator. In particular, a constant speed avoids issues with regard to inertia (given the large mass of a six axis multiaxial manipulator). Stress on the manipulator is significantly lowered where the displacing motion is essentially continuous. The laser beam position is then controlled, during the displacing motion, to include movement with a direction opposite to the direction of the displacing motion. With the oppositely directed motion, the weld can be formed at a lower welding speed, as compared to the speed of the displacing motion. Further, so-called stitches can be formed relatively rapidly. The compensating motion is preferably performed by means of a pivoting motion of the manipulator hand (robot hand) about one of the hand axes. This type of motion can be carried out rapidly and controlled very accurately. The hand axis is preferably independent and can be controlled independently from the displacing motion of the manipulator axes. The motion of the hand axes, especially along the axis located far away from the driven side, allows the advantage that the masses involved are quite low, which permits a low-inertia compensating motion. The laser tool may also be mounted by means of an extension arm as described. With an extension arm a distance is provided such that small angles of rotation of the hand axes are sufficient to obtain great

compensating motions and compensation paths. The transmission ratio or the leverage applied can be changed by changing this distance. The prior art as a whole fails to suggest features to achieve the process according to the invention. Further, the prior art fails to teach or suggest the structural combination of the device claims.

US 5,132,887 (Torii et al.) only shows a robot with a linear axis at the end. It does not appear that Torii et al. discloses a robot hand. The linear axis at the end is for moving the laser collecting unit 22 back and forth along the beam direction in order to keep the distance and the focus on the work piece. This quickly reacting mechanism 62,64 for the linear Z-axis shall move the lightweight laser collecting unit 22 instead of the sluggish robot arms. During welding there is only a displacement motion of the robot in a forward direction following the path, but no oppositely directed compensating motion of the laser beam. Torii discloses a compensating motion of the laser collecting unit 22 (for the purpose of constant distance), but not of the laser beam and not in a direction opposite the displacement motion of the robot in a forward direction following the path. As such, Torii et al. fails to teach and fails to suggest each of:

holding a laser tool that emits the laser beam by a multiaxial mechanical manipulator at a manipulator hand at a spaced location above the workpiece;

moving the laser tool along a predetermined path along the workpiece by the displacing motion of the manipulator during the displacing motion of the manipulator; and

superimposing a compensating motion of the laser beam to the displacing motion during the displacing motion with the compensating motion being at least partially oppositely directed to the displacing motion.

It is these features of the invention that provide significant results. The combination of features allow a smooth and continuous movement of the manipulator while also providing a weld seam formed at a slower rate. By moving the weld seam via the robot hand with the direction at least partially opposite the direction of movement of the manipulator itself, larger and faster movements of the manipulator can be provided without the disadvantages of the prior art. The prior art including Torii et al. fail to provide meaningful teachings which would render the subject matter obvious. Accordingly, reconsideration of the rejection based on Torii et al. is respectfully requested.

Claims 4 and 5 have been rejected under 35 USC 103 (a) as being obvious based in the teachings of Torii et al. in view of Matsuo et al.

As pointed out above, Torii et al. fails to provide meaningful teachings with regard to a process and a device with a manipulator moving a laser tool along a path along a workpiece in a displacing motion with the laser beam moved in an opposite direction with a compensating motion. The prior art including Torii et al. fails to provide any suggestion of this and fails to provide any direction which would lead the person of ordinary skill in the art toward this process and toward a device with these features.

Matsuo et al. discloses a method and apparatus for welding a workpiece with laser beams. The device includes a path changing mechanism for changing the laser beam path of

the laser beam from a first laser oscillator to another laser oscillator. The changeover occurs in the case of failure. This involves the concept of switching or changing between laser heads, namely from one laser head to another. The switching system may use one head until the end of initial work and switch to another head for further work. This does not involve the features according to the invention including moving the laser tool during a displacing motion provided by the manipulator and moving the laser beam with a compensating opposite motion. The prior art fails to recognize the advantages of the invention and does not provide direction with regard to providing the combination as claimed. The rejection does not establish a prima facie case of obviousness.

Claims 17 has been rejected under 35 U.S.C. 103 as being obvious based on the teachings of Torii et al. in view of Ito et al.

The prior art fails to suggest the combination of features of base claim 14. The combination is significant and is not obvious in view of the references. Although the references disclose various laser welding devices, the claimed combination is not taught and not suggested by the prior art. The teachings of Torii et al. in view of Ito et al. do not obviate the claimed combination.

Ito et al. (US 4,567,347) discloses a measurement had for welding machines. This is an arc welding machine with the reference primarily concerned with a laser light beam that is emitted with a receiving unit detecting the reflected beam. A position of a bright spot produced on the surface by the radiated laser light beam is computed from the detected angles based on the principle of triangulation. This reference, alone or in combination also fails to

suggest the combination of features claimed. Accordingly, reconsideration of the rejection is requested.

Claims 18 has been rejected under 35 U.S.C. 103 as being obvious based on the teachings of Torii et al. in view of Sumi et al. The prior art fails to suggest the combination of features of the base claims. The prior art also fails to suggest accommodation claim 18.

Sumi teaches a variable focal position optical system and light beam scanning apparatus. This is an arrangement which changes the focus position via lenses. This reference also fails to suggest the combination of features claimed. Accordingly, reconsideration of the rejection is requested.

Claims 19 has been rejected under 35 U.S.C. 103 as being obvious based on the teachings of Torii et al. in view of Bandelin et al (US 5,948,287).. The prior art fails to suggest the combination of features of the base claims. The prior art also fails to suggest the combination of claim 19.

Bandelin et al. discloses a process for the production of mask frames. This involves performing a welding operation with at least two starting components followed by forming where the components are fixed in position. A laser beam is used for welding. The power of the laser beam is modulated to produce a weld that increases in depth from the beginning of the weld and decreases in depth at the end of the weld. The teachings of the prior art as a whole including Bandelin et al fail to suggest the combination claimed. The invention provides more than anything suggested by the prior art. The claimed invention is not obvious in view of the prior art. Accordingly, reconsideration of the rejection of claim 19 is requested.

The other cited prior art references also fail to teach and fails to suggest the claimed combination of features.

Torii et al. '129 (US 5,140,129) discloses a multi-articulated arm type industrial laser robot in which the whole focus unit is moved. This reference also fails to suggest the combination of features claimed. The other reference is also fail to suggest the combination claimed such that the combination claimed patentably defines over the prior art as a whole. As the prior art as a whole fails to suggest the combination of features claimed, it is requested that the outstanding rejections be reconsidered.

Further and favorable action on the merits is requested.

Respectfully submitted
for Applicant,



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Attached: (1) Sheet of Replacement Drawings
Petition for One Month Extension of Time

SHOULD ANY OTHER FEE BE REQUIRED, THE PATENT AND TRADEMARK OFFICE IS HEREBY REQUESTED TO CHARGE SUCH FEE TO OUR DEPOSIT ACCOUNT 13-0410.

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